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A new subspecies of the Asiatic softshell turtle *Amyda ornata* (Gray, 1861) from its northern distribution range

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Abstract

We describe a new subspecies of *Amyda ornata* (Gray, 1861) from the southeastern parts of Bangladesh (Chittagong hill tracts), adjacent regions of north-eastern India (Mizoram, Assam and Tripura) and Myanmar, based on morphological characteristics. The holotype comprises some skeletal elements held by the Natural History Museum of Vienna; the five paratypes consist of living specimens in the private collection of PP "Turtle Island" (a turtle conservation zoo in Graz, Austria). After the genetic identity had been determined in a previous investigation, the morphological description was carried out by examining living specimens and photo documents; and additionally, by evaluating the computed tomography of further living animals with exact location data.
Amyda ornata jongli ssp. nov. differs from the other *Amyda ornata* subspecies mainly by its relatively compact and stout head in subadults and adults, its paler, greyish and less contrasting colouration missing distinct bright yellow pigments, ochre-coloured irises, and the existence of more distinct tubercles in the neck region and in the posterior section of the carapace than both other subspecies of *Amyda ornata*. The tubercles along the front of the carapace protrude clearly in subadult and adult specimens. This softshell turtle is heavily exploited within its limited distribution. Therefore, special comments on conservation aspects are given together with a final discussion on distribution and systematics.

Key Words

Amyda ornata jongli ssp. nov., Bangladesh, conservation, distribution, India, morphology, Myanmar, Reptilia, Testudines, Trionychidae, systematics

Introduction

The base of a good conservation strategy requires an in-depth knowledge of the ecology and distribution of the considered taxa, as well as a thorough understanding of its taxonomy. In the case of endangered species which are extensively harvested across their range, this is especially relevant. To make plans for sustainable commercial use in the future, data on systematics, distribution, habitat preferences, population biology and reproduction must first be studied and assessed (Kusrini et al. 2014).

Initially, *Amyda* Schweigger in Geoffroy Saint-Hilaire, 1809 was recognised as a monotypic genus, consisting only of one species *Amyda cartilaginea* (Boddaert, 1770). It has become evident however, that it represents in fact a species complex (Van Dijk 1992; Pawar and Choudhury 2000). It turned out to be difficult to allocate distinct morphotypes to geographic regions due to their considerable variability. Additionally, new occurrences of the Asian softshell turtle (*A. cartilaginea*) in outer northern and western parts outside of the former known distribution area of continental Asia were recorded in the

past two decades, but not yet published - although this was known from hunters in these regions. New documented distribution records from north-eastern India exist from Mizoram and Tripura (Pawar and Chaudhury 2000; Das et al. 2016; Hmar et al. 2020) and from Cachar district, Assam near Mizoram border (Nath et al. 2018). Recently, the Asiatic softshell turtle was even reported at the fish market in Guwahati (misidentified as "*Nilssonia hurum*", Anonymous 2020). Occurrences from the Chittagong hill tracts, Bangladesh, were published by Khan (2013 "2012"), and Rahman et al. (2015).

Fritz et al. (2014) started to disentangle the species complex of the Asiatic softshell turtle based on DNA data, and discovered the existence of three deeply divergent genetic lineages, two of which were restricted to the Sunda islands of Sumatra, Java and Borneo and Sulawesi (Koch et al. 2008). The third lineage concerns populations inhabiting the mainland of South East Asia. For this lineage the taxon *Amyda ornata* (Gray, 1861) was reinstated. *Amyda ornata* itself is polytypic and consists of at least three subspecies; namely *A. ornata ornata* (Gray, 1861) ("clade 6" sensu Fritz et al. 2014) inhabiting the Mekong River system in Laos and Cambodia; *A. ornata phayrei* (Theobald, 1868) ("clade 5" sensu Fritz et al. 2014) occurring in the Irrawady and Salween River systems in Myanmar; and a third distinct subspecies in Bangladesh and north-eastern India ("clade 4"), which is not yet officially described. The primary lack of voucher specimens in museums prevented Fritz et al. (2014) from describing this new subspecies. New material studied in the meantime, including living specimens and their ontogenetic changes, enabled the current description of the northern subspecies of the Asiatic Softshell turtle.

Materials and methods

Specimens: One skeleton and five living turtles from Sangu River near Dohazari. (CITES ex- and imports: 26/2013, 10/2015, AT 13-E 0057 and AT 15-E 0024).

The five living specimens were photographed, measured and weighed, and additionally scanned by computed tomography (CT). For reasons of comparison, computed tomography was also conducted on alcohol-preserved voucher specimens from the Natural History Museum Vienna, and additional living specimens from Schönbrunn Zoo, Vienna with known origin. CTs were conducted at the Department of Reproduction Management, Leibnitz Institute for Zoo and Wildlife Research, Berlin and was done along the coronal axis for a total of 505 slices. Each 1024×1024 pixel slice is 0.06822 mm thick, with an interslice spacing of 0.06822 mm and a field of reconstruction of 32 mm. Micro-CT scanning was performed with a phoenix|x nanotom m (GE Measurement & Control, Wunstorf, Germany) using a tungsten target at a voltage of 130 kV and a current of 80 µA for 29 minutes (1800 projections). 3D datasets were processed with VG Studio Max 2.2 software (Visual Graphics GmbH, Heidelberg, Germany); the data were visualized using the Phong volume renderer to show the surface of the skull and reflect a variety of different levels of x-ray absorption.

Additionally, photo documents of turtles with reliable local data were studied and compared alongside our dataset.

Systematics

Order: Testudines Batsch, 1788
Family: Trionychidae Gray, 1825
Subfamily: Trionychinae Gray, 1825
Genus: *Amyda* Schweigger in Geoffroy Saint-Hilaire, 1809
Species: *Amyda ornata* (Gray, 1861)
Subspecies: *Amyda ornata magnapapulae* Hoser, 2021 nomen rejectum according to Turtle Taxonomy Working Group (TTWG, 2021).

Amyda ornata jongli ssp. nov.

Holotype. NHMW 40278 (Natural History Museum Vienna, herpetological collection): subadult specimen; skull and lower jaw; incomplete postcranial skeleton: parts of discus, shoulder girdle, pelvic girdle and extremities (Figs 2–5). Measurements: bony disc length 10 cm, bony disc width 13,6 cm. Plastron: Straight width 14,9 cm. Skull: Straight length 6,6 cm, straight width 3,5 cm.

Terra typica. Sangu River near Dohazari, Chittagong hill tracts, south-eastern Bangladesh, don. P. Praschag 3/2016.

Paratypes. The paratypes consist of five living voucher specimens, one male and four females in the facility of "Turtle Island", NHMW 41463: 1–5 (Fig. 6a–j). Location of origin for all five paratypes: Sangu River near Dohazari (terra typica), Chittagong hill tracts, south-eastern Bangladesh (same location as holotype-specimen). The specimens will be transferred post mortem to the herpetological collection of the Natural History Museum Vienna. For measurements see Table 1.

Derivatio nominis. The subspecies name *jongli* (noun in apposition) refers to the special term of local fishermen in Bangladesh who call this softshell turtle "jongli" in Bengali, deriving from "jangala" in Sanskrit. It means wild and ferocious, as the animals are powerful and struggle when captured. Simultaneously it means also "…coming from rivers of jungle woodlands". Rahman et al. (2015) mention also the name "Tui-lip", used by the Mro tribe. Suggested common names: English: "Northern Asiatic softshell turtle". German: "Nördliche Knorpel-Weichschildkröte".

Taxonomic status. The Maximum Likelihood Tree for *Amyda* and related softshell turtles shows five distinct clades, divided into three species. Clades 4 ("Pale coloured, large nuchal and back tubercles" now herein described as *A. o. jongli* ssp. nov.), 5 ("*Trionyx phayrei*" / "*Trionyx ephippium*") and 6 ("*Trionyx ornatus*") show

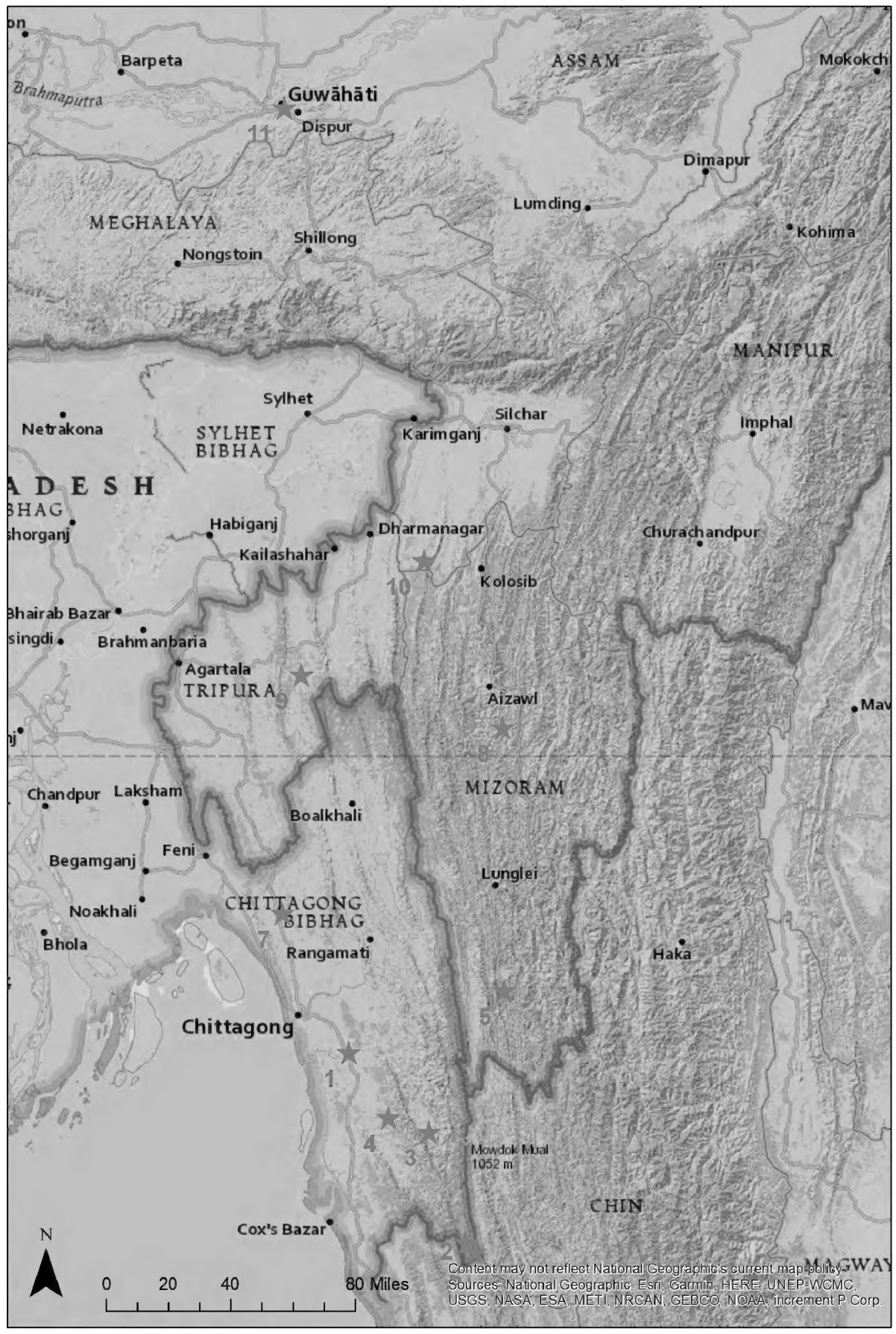

Figure 1. Known distribution records (Points 1–11) of *Amyda ornata jongli* ssp. nov., details see Table 2. National Geographic-Weltkarte – Content may not reflect National Geographic's current map policy. Sources: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

Table 1. Measurements of the paratypes, measurements (in cm), CL = Carapace length (straight length), CW = Carapace width (straight width at the broadest point = above hind legs), DL = Discus length (along median line), W = Weight (in kg).

Specimen	Date	Sex Juvenile (juv) Male (m) Female (f)	CL	CW	DL	W
NHMW 41463:1	09.02.2016	M	33.5	27.1	20.1	
NHMW 41463:1	26.04.2022	M	41.4	33.4	26.4	9.78
NHMW 41463:2	09.02.2016	F	37.5	30.5	22.3	
NHMW 41463:2	26.04.2022	F	42.0	34.8	27.4	10.21
NHMW 41463:3	09.02.2016	F	28.7	23.6	18.5	
NHMW 41463:3	26.04.2022	F	34.7	28.0	21.2	5.57
NHMW 41463:4	09.02.2016	Juv	22.1	18.7	15.0	
NHMW 41463:4	26.04.2022	F	33.6	27.2	21.6	5.07
NHMW 41463:5	09.02.2016	Juv	21.9	18.7	15.1	
NHMW 41463:5	26.04.2022	F	28.3	23.5	23.9	3.58

similar levels of genetic differentiation from each other, and constitute the three identified subspecies from Mainland Southeast Asia (Fritz et al. 2014).

Diagnosis on morphological base. The heads in subadults and adults are stout (see Figs 5, 7a), with a dome rising up steeply from the top of the proboscis to the top of the head, in the region of prefrontals and frontals (see Fig. 9). Compared to the two other subspecies of *A. ornata*, a broader distance between the eyes is seen in *A. o. jongli* (see Figs 3, 7b), although this relative distance varies depending on the ontogenetic stage of the specimen considered. Rather uniform pale and greyish colouration, carapace is olive greyish, bright yellow pigmentation missing (Fig. 6a–j). Yellow-greyish dots, and vermiculation on head and neck is faded and not distinctly marked, ochre-coloured irises,

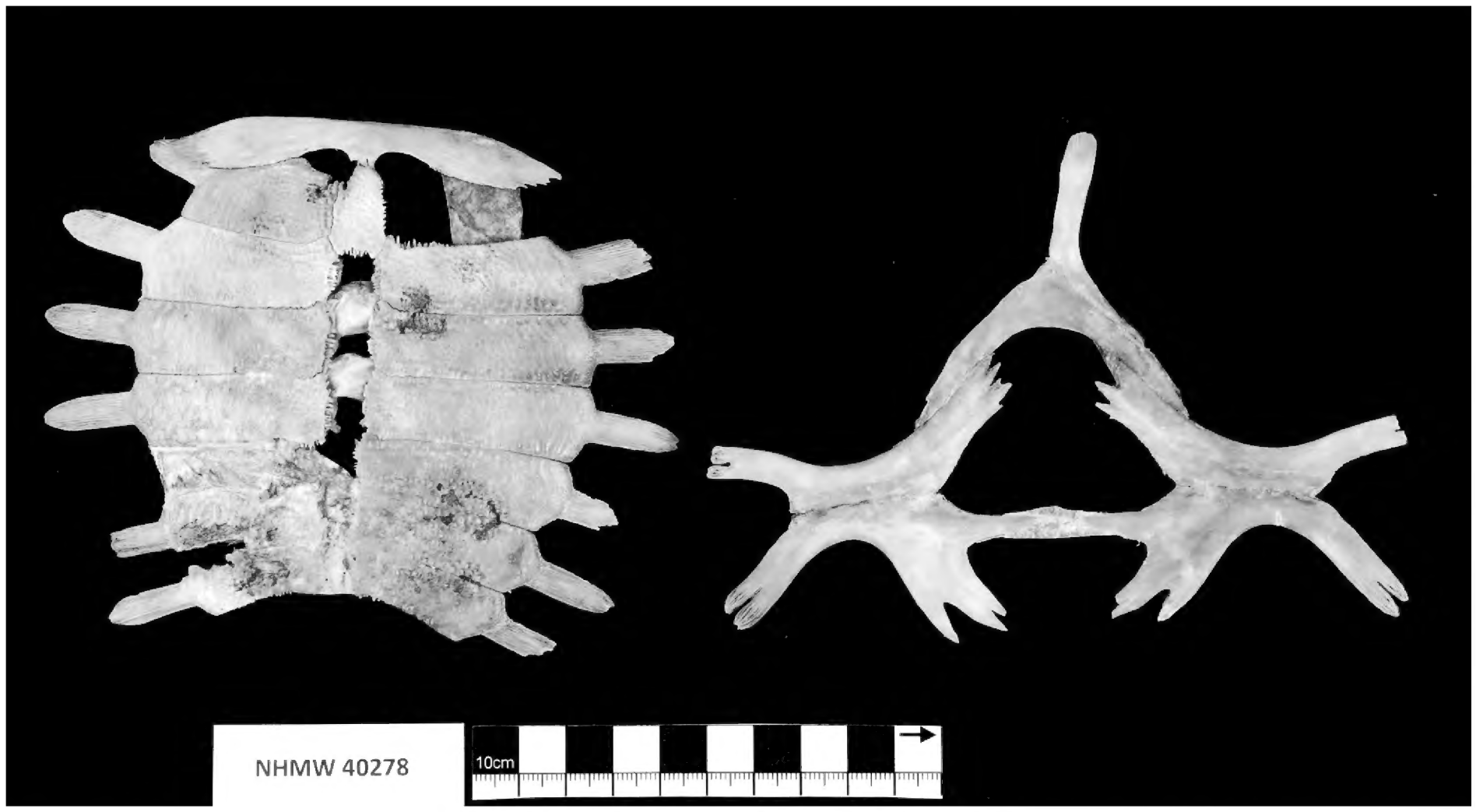

Figure 2. Holotype (NHMW 40278) of *A. o. jongli* ssp. nov. Bony elements of carapace (dorsal) and plastron (dorsal/visceral). Some neurals, 1st pleural right, left epiplastron and xiphiplastra missing. Photo: Natural History Museum Vienna, Alice Schumacher.

Figure 3. Holotype (NHMW 40278) of *A. o. jongli* ssp. nov. Lower jaw (dorsal with alveolar surface of mandible) and skull (dorsal). Photo: Natural History Museum Vienna, Alice Schumacher.

ring-shaped skin around eyes with indistinct light dots, no pronounced "zebra striped" pattern; carapace with (or sometimes without, but less common) distinct black strokes and blotches or irregular saddle-shaped dark colouration on carapace (see Fig. 9). Black pigmentation mostly in the form of square spots on the rear edge of the carapace and two or three stripes running sideways from the center line of the carapace (compare Fig. 6a–j of the paratypes). Distinct tubercles in nuchal and back region. Nuchal tubercles protrude in a round or pointed shape along the front edge of the carapace in subadult and adult specimens (Fig. 8). Juveniles with tubercles on carapace running concentric, not longitudinal. Plastron white (in juveniles) changing to yellowish-grey during growth, mottled with clouds of black pigments especially on the parts of underlying bony skeleton.

Diagnostic comparisons. The genus *Amyda* is distinguished from all other trionychids by the following suite of characteristics:

Carapace with black markings, sometimes black and yellow or bright dots, but no ocelli; skull: snout longer than the diameter of the orbit (more in juveniles than in adults); alveolar surface of the mandible with a longitudinal ridge at the symphysis; surface of jaws light; first and second neural fused; epiplastra in contact or narrowly separated, front part of epiplastra are elongated (see Fig. 7c); further detailed skull morphology is given by Van Dijk (1992).

A. ornata differs from *A. cartilaginea* (sensu stricto) and *Amyda* sp. (= candidate species A, sensu Fritz et al. 2014) by the stouter head versus narrow head tapering lengthwise with a longer proboscis.

Amyda o. ornata differs from the other two subspecies by its distinct yellow pigments on carapace, head and neck; the presence of a "crown": two or three converging black lines forming an arrow on the upper side of the head; tubercles predominantly in the nuchal and front region of the carapace; saddle-shaped dark colouration on carapace uncommon. Distribution: Vietnam, Laos, Cambodia (Chaco Phraya, Irrawaddy and Salween River systems).

Amyda o. phayrei differs from the other two subspecies by its dull brown carapace, yellow pigments present forming distinct yellow dots on the head and neck; carapace with or without distinct saddle-shaped dark colouration; with eyes open, the eyelids have distinct yellow spots alternating with grey "zebra striped" colouration; tubercles in the nuchal and back region of the carapace but not as distinct as in *A. o. jongli* ssp. nov.; head in upper side view more slender and narrowed to the pro-

Figure 4. Holotype (NHMW 40278) of *A. o. jongli* ssp. nov. Skull in ventral view. Photo: Natural History Museum Vienna, Alice Schumacher.

boscis. Distribution: Thailand, Myanmar (delta region of the Irrawaddy (Ayeyarwady) and possibly neighbouring Salween (Thanlwin) river, NE India (Mizoram) and Yunnan (Kuchling 1995).

Distribution data of *Amyda ornata jongli* ssp. nov. (Fig. 1, Table 2). **Bangladesh**: Chittagong hill tracts: Sangu River system [=Sangpo river, Sankho river, Shankha River] and tributaries, Matamuhuri river; Karnaphuli river system. Sangu River: Dohazari (Terra typica) (Fig. 1, pt 1); four Mro villages along upstream of Sangu River in Sangu-Matamuhuri Reserve Forest (villages Nr. 23, 24, 25 and 26 in Fig. 1, Rahman et al. 2015) (Fig. 1, pt 2); Thanci Upazila [=Thanchi]: "rocky hill stream Remakri Khal" in Bandarban and Mro village "Nepew Para" (Khan 2013 "2012"), (Fig. 1, pt 3); village on the Matamuhuri River (village Nr. 1 in Fig. 1, Rahman et al. 2015) (Fig. 1, pt 4); Sangu River at Remarki, border to Myanmar Fatik Chhari (pers. comm. Scott Trageser, Comitee Creative Conservation Alliance) (Fig. 1, pt 6); Durung Khal river, mouth of the Halda river (pers. comm. Sureshchandra Das) (Fig. 1, pt 7).

India: Mizoram: Ngengpui River, Ngenpui Wildlife Sanctuary, Lawngtlai (Pawar and Choudhuri 2000): bony disc deposited in the holdings of the Museum of Bombay Natural History Society under BNHM 1446 as confirmed by Rahul Khot, Curator of National History Collection department of the Bombay Natural History Society (pers. comm. 7th, April 2016) (Fig. 1, pt 5); Tuirial River drainage, Aizawl District (Hmar et al. 2020) (Fig. 1, pt 8) (additionally occurring in most of the major river systems of the northern part and documented here from the rivers Teirei, Tut, Tlawng, Tuirini, Tuirial, Tuivawl & Tuipuibari, pers. comm., 6th March 2016 Tlau Vanlal Hrima, not considered in Fig. 1);

Tripura: Narichera Stream, North District (Das et al. 2016) (Fig. 1, pt 9);

Assam: Dhalchera river, Phaisen Hills, Cachar District (Nath et al. 2018) (Fig. 1, pt 10), fish market, Guwahati (Anonymous 2000) (Fig. 1, pt 11).

The area registered in the distribution records comprises two main river systems separated by a watershed running through the centre part of Mizoram: the southern region in southern Mizoram and Chittagong hill tracts containing Sangu River as a part of the "Kolodyne Basin" and draining in the Bay of Bengal. The northern part is situated in northern Mizoram Assam and Tripura and is dominated by the Barak River system ("Barak Basin") draining into the Brahmaputra; in the recent past a specimen was even reported from the fish market in Guwahati, Assam (Fig. 1, pt 11).

Table 2. Waypoints of known localities of *A. o. jongli* ssp. nov.

Point (pt)	Locality	Coordinates (WGS 84) (Latitude, Longitude)
1	Dohazari (Terra typica), Bangladesh	22.163958, 92.065016
2	Sangu River – CHT, Sangu-Matamuhuri Reserve Forest, Bangladesh (Rahman et al. 2015)	21.3455827, 92.6069887
3	Thanchi upazila, Bandarban, Bangladesh (Khan 2013 "2012")	21.8217887, 92.4377149
4	Matamuhri river, Bangladesh (village Nr. 1 in Fig. 1, Rahman et al. 2015)	21.8830881, 92.2497277
5	Ngengpui River, Ngengpui wildlife sanctuary, Lawngtlai, Mizoram, India (central point selected for map)	22.43134, 92.7867
6	Sangu River at Remarki, Fatik Chhari, border to Myanmar, Bangladesh	21.3030315, 92.6511433
7	Durung Khal River, mouth of the Halda river, Bangladesh	22.7612597, 91.755951
8	Tuirial River drainage, Aizawl District, India (Hmar et al. 2020)	23.555, 92.779
9	Narichera Stream, tributary of Khowai River, North District, Tripura, India (Das et al. 2016)	23.7804, 91.8430
10	Dhalchera, Phaisen Hills, Cachar district, India (Nath et al. 2018)	24.264611, 92.415256
11	Guwahati, Assam - Fish market, India (Anonymous 2000)	26.16945, 91.76448

Discussion

Questions of systematics and nomenclature

Auliya et al. (2016) argued that the phylogeny of the softshell turtle genus *Amyda* may be more complex and demand a more precise analysis for range-wide populations. Therefore, they judge the study of Fritz et al. (2014) only as a step and offer the results of this study as an "alternative taxonomic order" as originally published by the TTWG (2017). Due to the fact that the mtDNA tree was not highly resolved, the species complex of *Amyda ornata* was also only partially recognised by the TTWG (2017) as well, and the strange solution was chosen to name the *Amyda* populations of the Indochinese peninsula under both names, *A. ornata* and *A. cartilaginea*, without paying attention to the fact that other turtle taxa are considered as valid herein based on much weaker characteristics. Eventually, the TTWG adopted the concept of Fritz et al. (2014). In the meantime, the complete mitochondrial genome of *A. ornata* ("*A. cartilaginea*") from Dianchi Lake, Kunming, Yunnan, China (occurrence in the distribution area of *A. o. ornata*, but not registered in TTWG 2021) was sequenced (Cui et al. 2020), and may help for further studies. Sexual chromosomes of the paratype-specimens of *A. o. jongli* ssp. nov. (as "*A. cartilaginea*") were used for the study by Rovatsos et al. (2017) (as "*A. cartilaginea*").

The given characteristics and diagnostic features should enable the distinction of this subspecies from the two other currently recognised subspecies of *A. ornata*, as well as from *A. cartilaginea* sensu stricto, although it will not be possible to assign single specimens in every case due to the intraspecific variability of the species, the ontogenetic changes and the anthropogenic transport/translocation of numerous specimens in the past. Distinct colour patterns on the carapace with black marks as described above for *A. o. jongli* ssp. nov. and/or a vertebral stripe may appear in different populations of *Amyda* including *A. ornata* too, but not as consistently as in *A. o. jongli* ssp. nov. *Trionyx ephippium*, described by Theobald (1875), and based on a single juvenile specimen from Tenasserim is characterised by the name-giving irregular saddle-shaped dark patches

Figure 5. Holotype (NHMW 40278) of *A. o. jongli* ssp. nov. Skull in lateral view. Note the convex structure of frontal, prefrontal and maxillary. Photo: Natural History Museum Vienna, Alice Schumacher.

on the back and missing "ocelli" on carapace similar to *A. c. maculosa*. It strongly resembles *A. o. jongli* ssp. nov. concerning faded dots and vermiculation on head and neck too, but was tentatively assigned to *A. o. phayrei* by Fritz et al. (2014) mainly on zoogeographical reasons. However, its identity remains doubtful.

Ontogenetic change and problems of identification

As shown by Praschag and Gemel (2002) changes in morphological features such as colouration and markings - especially in softshell turtles - may change considerably during ontogenetic development of individuals. Therefore, colouration and ornamentation may be a good medium to distinguish different species only during juvenile stages as already stated by Gray (1861) when describing *Trionyx ornatus*. Accordingly, the colouration of softshell turtles is important for distinguishing different species and subspecies from each other and in some cases it may reflect genetic differences. But it should be noted that the colour of softshell turtles may change depending on the colour of the river bed and surroundings (Thomas 1967). This phenomenon extends to limbs and soft parts of turtles and is reversible. Therefore, attention should be paid to judging specimens from different habitats (eg. dark or bright river beds) or from care in captivity. Additionally, giant growth has been recorded in *A. ornata*. Single specimens of *Amyda* may reach considerable lengths and weights, and there might exist the phenomenon of gigantism in this softshell turtle genus. Weight up to 202 kg was recorded in an *A. ornata* from the Chao Phraya River system in Thailand (Bonin et al. 2007). Even if this report may be doubtful, this species reaches documented carapace lengths up to 80cm (Ernst et al. 2000; Iskandar 2000; Kusrini et al. 2014). Sometimes such huge specimens are confused even with the giant softshell turtle *Pelochelys cantorii* (Jang 2009). Accordingly, (very) old specimens may not have traces of diagnostic features regarding colouration and tubercles. Adult and large specimens of *Amyda* can be identified and separated from the other trionychid genera *Chitra*, *Pelochelys* and *Nilssonia* by the following combination of features: position of the eyes, noticeable behind front part of head; proboscis is slender, straight and elongated; distinct nuchal tubercles; callosities on plastron weak or missing; front parts of epiplastra elongated and touching each other (or at least close together).

Notes on the distribution range

Softshell turtles are closely connected to freshwater systems. As shown by Fritz et al. (2014) all three genetic lineages of *Amyda* on Borneo correlate with paleodrainage systems, while on the other Great Sunda islands Sumatra and Java, only one lineage exists on each island. In continental Southeast Asia, a correlation of all three known subspecies with large river systems can be stated, the regions separated by hill and mountain barriers: *Amyda o. ornata* inhabits the Mekong River region (Vietnam, Laos Cambodia),

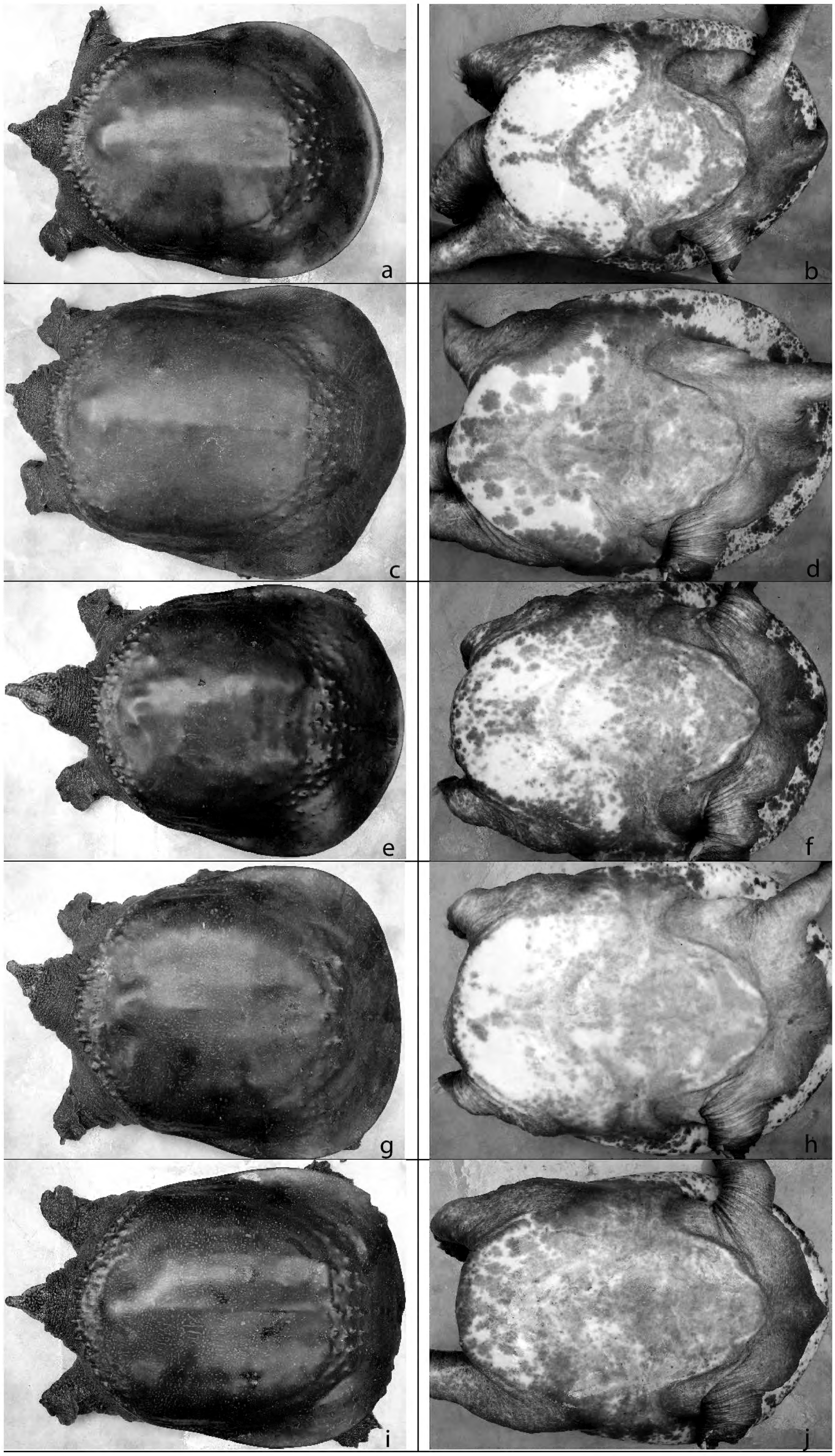

Figure 6. Paratypes, NHMW 41463:1 (**a, b**); NHMW 41463:2 (**c, d**); NHMW 41463:3 (**e, f**); NHMW 41463:4 (**g, h**); NHMW 41463:5 (**i, j**), living specimens of *A. o. jongli* ssp. nov. in the holdings of "Turtle Island", dorsal and ventral view. Photos: Peter Praschag.

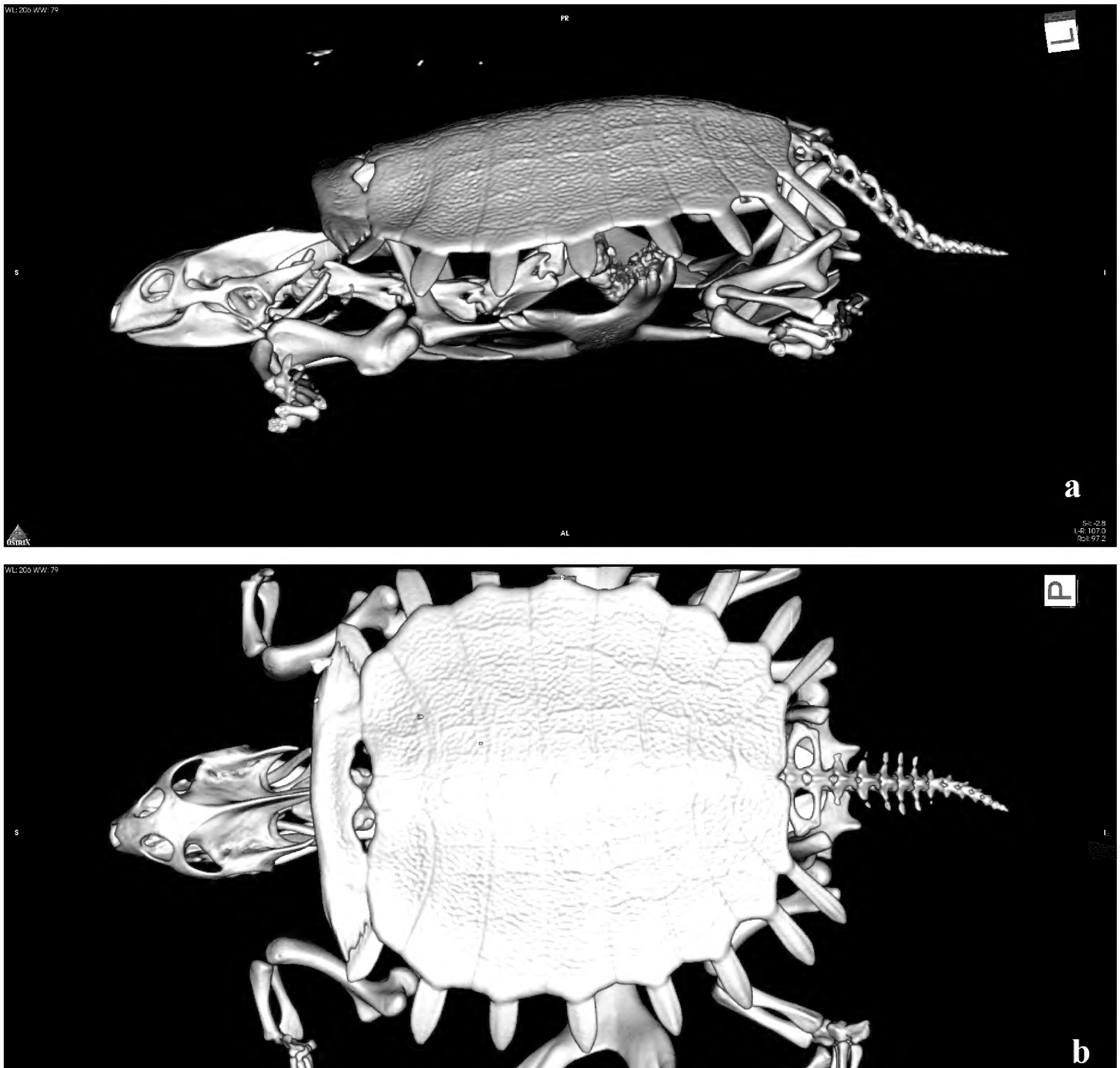

Figure 7. (a–c) Computer Tomography of *A. o. jongli* ssp. nov, NHMW 41463:1. Photos: Thomas Hildebrandt and G. Fritsch, Department of Reproduction Management, Leibnitz Institute for Zoo and Wildlife Research.

A. o. phayrei the Chaco Phraya, Irrawadi, and Salween region (China, Myanmar, Thailand) and *A. o. jongli* ssp. nov. is restricted to the rivers of the Arakan hills, Sangu, the Karnaphuli River system and the "Barak Basin", Brahmaputra, in north-eastern India and Bangladesh (although not recorded especially from "Barak Basin" by Das and Gupta 2011).

Most of the rivers originate in the central part of Mizoram and flow either southwards or northwards, corresponding to the north-south directed mountain and hill chains. The main northerly flowing rivers of Mizoram are Tlawng, Tut, Tian, Tuichawng, Tuirial, Tuivawl, Teirei, Tuirini, and Serlui. The largest of these is the Tlawng (Dhaleshwari) with a length of about 185 km. The Tlwang, Tuirial and Tuivawl Rivers drain into the Barak River directly. All other rivers meet the Barak River through indirect and subsidiary channels either via Tripura-Bangladesh or via Manipur. Ultimately, the northerly flowing rivers of Mizoram, drain into the Barak River and constitute a part of the "Barak Basin". The Barak River, in due course drains into "Brahmaputra" as its left bank tributary (Verma 2018). The specimen from the fish market in Gauhati deserves great attention, as it can be assumed that this animal originates from the surrounding area, but no records exist from that area currently.

The Kolodyne Drainage System is formed of the south flowing rivers, with the Kolodyne River originating in the central state of Myanmar and draining into the Bay of Bengal southward to Sittwe (Verma 2018).

The Sangu River flows through Myanmar and Bangladesh, its source is in the North Arakan Hills of Myanmar and forms the boundary between Arakan and the Chittagong Hill Tracts. It follows a northerly circuitous course in the hill tracts and then enters Bangladesh near Remarki, Thanchi Upazila, Bandarban District, from the east. It flows north through Thanchi, Rowangchari and Bandarban Sadar Upazilas of Bandarban District. It then flows west through Satkania and Banshkali Upazilas in Chittagong District and flows into the Bay of Bengal near Chittagong, about 16 kilometres south of the mouth of the Karnaphuli River. Sangu drains off the waters of Patiya, Satkania, and Banshkhali Upazilas and has a connection with the Karnaphuli River through the Chand Khali River. *A. o. jongli* ssp. nov. has not been recorded in the Karnaphuli River. The Sangu is a shallow river, but it becomes violent during rains and develops rapid currents. Thus, the Sangu River System, along with the Karnaphuli River, form a river system that is neither connected in the north to the Brahmaputra, nor in the south to the Irrawaddy River system.

Figure 8. Tubercles are visible, protruding over the front of the carapace in the nuchal and back region in subadult and adult animals. Photo: Peter Praschag.

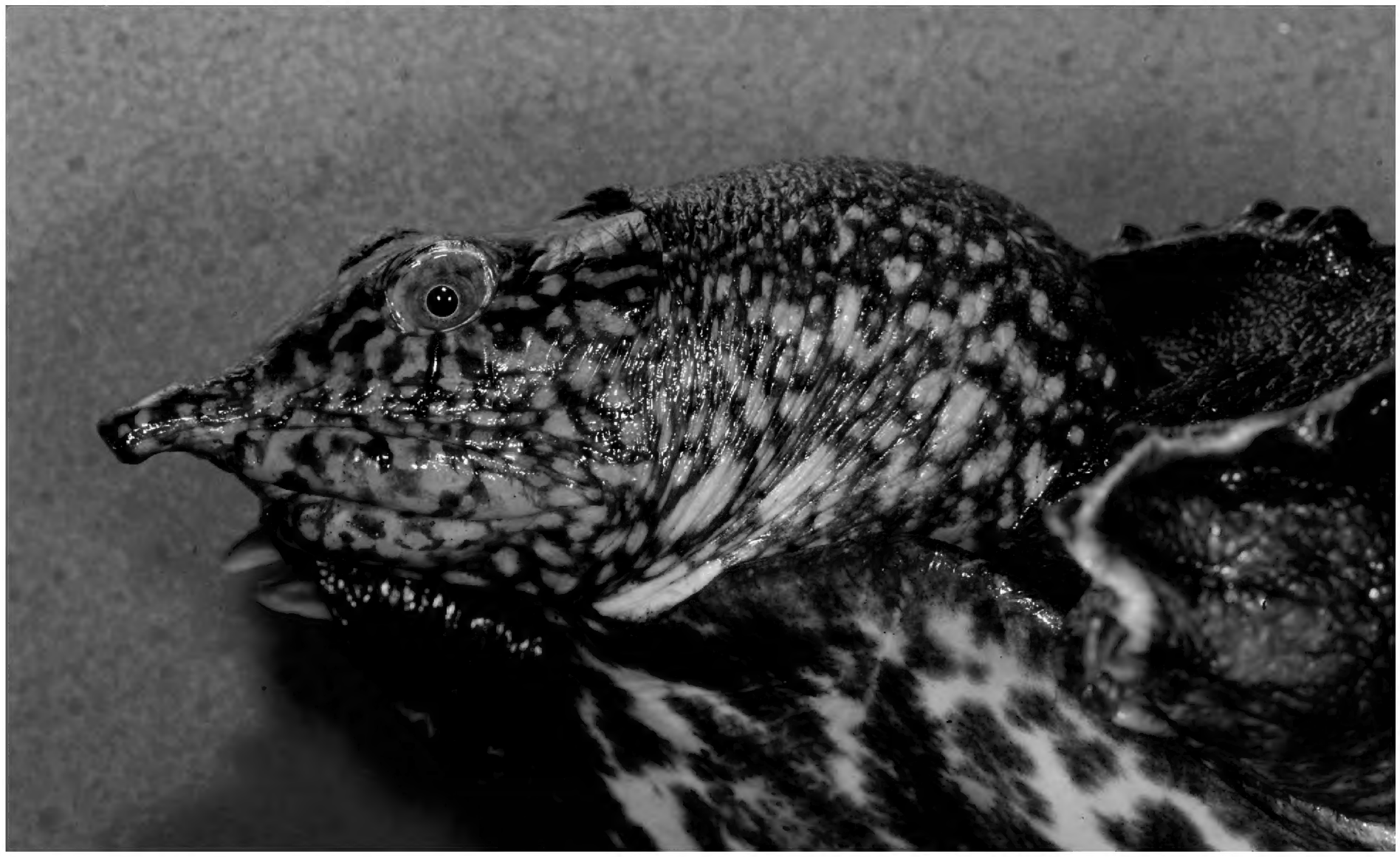

Figure 9. Lateral shot of the head of a living *A. o. jongli* ssp. nov. showing the ochre-coloured eyes and the shape of the head. Photo: Peter Praschag.

Conservation aspects

Based on the out-dated taxonomic concept, the IUCN Red List categorises "*Amyda cartilaginea*" (species group as a whole including *A. ornata* as "synonym") as vulnerable (Asian Turtle Trade Working Group 2016). This assessment should be updated considering the current taxonomic status. Asiatic softshell turtles are listed on Appendix II of CITES (as "*A. cartilaginea*").

As the first reports of occurrence of *Amyda* in Bangladesh were only published in 2013 for the first time (Khan 2013 "2012"), the species was not included in the fauna inventory of Bangladesh by Kabir et al. (2009). As such, conservation measures in this area are debated (Rahman et al. 2015). According to Hrima (pers. comm.) the Asiatic Softshell turtle is widely distributed within Mizoram, but not common. It is hunted heavily along the borders for its meat and occasionally surfaces in the local markets. Populations seem to decrease rapidly over time judging from the availability in markets. The population in the Matamuhuri River also declined due overharvesting (Rahman et al. 2015).

Softshell turtles in general, and *Amyda* especially, are heavily exploited for consumption over almost all parts of their distribution (Iskandar 2000; Kusrini et al. 2014; Rahman et al. 2015; Auliya et al. 2016). Due to their high importance as food, *A. ornata* seems to be displaced and carried into other regions, especially into or out of the Chaco Phraya region, although not bred in farms in high numbers like *Pelodiscus sinensis* (Wiegmann, 1835). Therefore, it is difficult to evaluate, if captured specimens or ones observed in markets today are representatives of autochthonous populations. In the special case of *A. o. jongli* ssp. nov. it can be assumed that animals were not introduced or released in its region, but rather were marketed locally or exported in the past to other regions due to the remoteness of their locations. Overexploitation may be responsible for the fact that recent reports of its occurrence exist only from the headwaters of the major river systems. One exception is the report of a specimen from the fish market in Guwahati suggesting that the current occurrence in the upper parts of the rivers may be a relict occurrence and that *A. o. jongli* ssp. nov. may have been more widespread in the lower elevations in earlier times.

The distinct taxonomic position of *A. o. jongli* ssp. nov. correlates with distribution patterns of other trionychid and aquatic geoemydid turtles in that the Arakan mountains form the eastern border of the roofed turtle genus *Pangshura*, as well as for the semiaquatic Geoemydid genus *Melanochelys*. The Arakan mountains separate also the sister species *Chitra indica* (Gray, 1831) from *Chitra vandijki* McCord & Pritchard, 2003, as well as *Lissemys punctata andersoni* Webb, 1980 from *Lissemys scutata* (Peters, 1868).

Interestingly, however, in the case of *Morenia petersi* (Anderson, 1879) and *Morenia ocellata* (Duméril & Bibron, 1835), the Arakans do not form a natural barrier, as *M. ocellata* can be found both east and west of these mountains, with *M. petersi* just to the west.

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